The Place of Tracheostomy in Tetanus Neonatorum

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It has been shown that total curarization and intermittent positive pressure respiration (IPPR) improves the prognosis of newborn babies suffering from tetanus (Wright, Sykes, Jackson, Mann, and Adams, 1961), but facilities for its use are not always available. The physician responsible for treating a patient may have to turn to simpler means such as tracheostomy. Some consider this essential (Creech, Woodhall, and Ochsner, 1950; Smythe and Bull, 1961), while others have failed to show any advantage from its use (Wright, 1960; Veronesi, 1956), and many have pointed out its dangers (Liston, 1844; Durham, 1869; Reading, 1949, 1958; Hugh-Jones, 1959; Smythe, 1963; Plum and Dunning, 1956; Stothers, 1956; Forbes, Salmon, and Herweg, 1947).

In the investigation reported here an attempt is made to evaluate the place of tracheostomy in neonatal tetanus.

Material and Methods

Studies were made on 95 newborn babies in the Tetanus Research Unit. They were divided into three groups: *Group A*, where criteria for tracheostomy were present; operation performed. *Group B*, where criteria for tracheostomy were present; operation *not* performed. *Group C*, where criteria for tracheostomy were absent; operation *not* performed.

The selection of patients for Groups A or B depended upon the availability of respirators. The number of respirators available made it impossible for all patients to have IPPR.

The decision to select according to availability of a respirator and not by random sampling was based upon the ethics of depriving neonates of a form of treatment—IPPR—which was known to reduce mortality, in favour of one—tracheostomy—which Wright (1960) abandoned because it did not improve prognosis.

The criteria for tracheostomy were as follows. (1) The presence of more than one spontaneous spasm per 10-minute period of observation following an initial dose of chlorpromazine and phenobarbitone (see below); or (2) flaccidity in a baby who had been admitted hypertonic with severe spasms; or (3) crowing respira-

tion (suggesting laryngeal spasms); or (4) central cyanosis; or (5) gasping respiration.

Not infrequently, babies selected developed more than one of the criteria simultaneously. No baby was selected after the 5th day following admission, even if one of the criteria was present.

In some cases it was necessary to resuscitate the baby before operation. Those with cyanosis and gasping respiration were resuscitated by artificial respiration (mouth-to-mouth, or intubation and mouth-to-tube). This rarely failed to restore normal breathing, though in some patients it was necessary to continue for 10 minutes. If by then the baby was not breathing normally he was connected to the respirator and mechanical ventilation was given during tracheostomy. At the conclusion he was disconnected from the machine and observed for establishment of normal breathing as described below.

Before tracheostomy and during the 'trial of tracheostomy' the subjects were treated for tetanus by means of antitetanus serum, antibiotics, and sedation (chlorpromazine and phenobarbitone). The dose of antitetanus serum was 50,000 units intramuscularly (i.m.) (Laurence and Webster, 1963). Procaine penicillin 150,000 units i.m., the antibiotic routinely used, was given for 10 days. Where indicated, other antibiotics were added. Chlorpromazine, 12.5 mg. four-hourly i.m., was used as the principal sedative and where necessary phenobarbitone, 66 mg. i.m., was given to increase sedation.

The tracheostomies were done by the author or by Dr. A. K. Thambiran. Babies were wrapped in a blanket to prevent movement and placed in a cot standing next to the respirator. Local anaesthetic (2% lignocaine) was injected into the skin and tissues lying over the trachea which was then exposed and opened, using a 1 cm. longitudinal incision with its lower edge at the level of the sternal notch. The tracheostomy tube was a shortened nylon reinforced latex endotracheal tube (6.5 cm.) introduced into the trachea and held in place by a special clamp of our own design (Sykes, 1960).

At the conclusion of the operation the tracheostomy tube was attached to the respirator by a T-piece, but the respirator was not started. The baby could breathe through a side opening, but in the event of respiration failing artificial respiration could be given without delay.

An attendant, either the author or a senior nurse, then sat at the bedside to observe progress. If the tracheostomy made no difference and cyanosis or gasping respiration returned, the resuscitation procedure out-

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lined above was tried. If this failed to restore normal breathing, the trial of tracheostomy was discontinued. The baby was then treated according to the IPPR regimen previously described (Mann, Jackson, and Holloway, 1963).

If the criteria for tracheostomy had been flaccidity or continuous spasms, the subject was observed closely for the development of cyanosis or gasping respiration. When these occurred, or if the spasms became so frequent as to be associated with every breath, treatment was attempted. For continuous spasms 66 mg. phenobarbitone was given i.m. and 30 minutes allowed to elapse for the drug to take effect. For cyanosis and gasping respiration the resuscitation technique above was used. If either of these failed, the trial was discontinued and IPPR used.

The criteria for giving IPPR were cyanosis, gasping respiration, and apnoea in those patients who lost the ability to respond to resuscitation. For the purpose of this study these criteria were taken to constitute respiratory failure.

Results

Of the 95 newborn babies, 70 developed one of the criteria for tracheostomy. Of these, 47 had tracheostomies (Group A) and were observed for progress. All of them developed respiratory failure and were given IPPR. The mortality in this group was 53% (25 died).

Of the remaining 23 (Group B) who developed the criteria for tracheostomy but who had neither tracheostomy nor respirator treatment, 21 died (91%).

The difference in mortality between Group A (with tracheostomy and IPPR) and Group B (criteria for tracheostomy but no further treatment) was statistically significant ($p < 0.01$).

All 25 patients in Group C (those who did not develop the criteria for tracheostomy) survived. The difference in mortality between Group A and Group C was statistically significant ($p < 0.001$).

The mortality in the three groups of patients is given in the Table.

TABLE
Mortality in Three Groups of Patients

Group	No. of Patients	Survived	Died	Mortality (%)
A	47	22	25	53
B	23	2	21	91
C	25	25	0	0

Discussion

All the babies who died in Group B (no tracheostomy or respirator) suffered episodes of respiratory arrest. In most the final episode was one of many,

but whereas early on they responded to resuscitation, eventually this response was lost. The babies in Group A also suffered episodes of apnoea, but when they lost their ability to respond they were prevented from continuing respiratory arrest by artificial respiration.

The third group, who received no treatment other than sedation, differed from the above two in not developing the criteria for tracheostomy and having the lowest mortality.

These findings indicate a close correlation between the development of respiratory failure and poor prognosis. The patients with the lowest mortality were those who never developed signs which we now recognize to be associated with eventual respiratory failure (frequent spasms, flaccidity, crowing respiration, cyanosis, and gasping respiration), and if those who did (Group A and B) were given respiratory assistance (Group A) the mortality was lower.

It is of practical interest to know whether there is any correlation between respiratory failure and the severity of the disease. Unfortunately there are at least three methods for estimating severity and though they give similar results there are differences which can lead to confusion.

Spivey, Grulee, and Hickman (1953) classified their patients according to severity, using the time between the occurrence of the wound and the first symptom (incubation period). He believed that an incubation period of less than 7 days was associated with severe tetanus.

Cole (1940) introduced the period of onset (time between the first symptom and the first spasm) and showed that a short period of onset was associated with the disease in a severe form.

Adams (1958) confirmed Cole's findings and added that a correlation existed between the frequency of spasms on admission and the severity of the disease. One or more spasms during a 10-minute undisturbed observation period occur in patients with severe tetanus. At the other end of the spectrum are those patients with mild tetanus who, no matter how stiff they become, never have spasms. Patients whose frequency of spasms lies between these two extremes are said to have moderate tetanus (E. B. Adams, 1966, personal communication). This was confirmed by Wright (1960), who found this classification more useful than one based on incubation period or period of onset.

The classification suggested by Adams has particular value when the population concerned is unsophisticated, as for example the rural African. Under these circumstances the history may be

unreliable and the medical attendant may be forced to depend on his own observations of the patient.

The mean incubation period of the patients in Groups A and B was 6.0 and 6.8 days, respectively, while those in Group C had a mean period of 9 days. The mean periods of onset were Group A, 7 hours; Group B, 6.4 hours; and Group C, 26 hours.

To be able to divide patients according to period of onset or incubation period and to have some certainty that the division has meaning in terms of correct treatment is difficult.

Adams (1958) found poor correlation between prognosis and incubation period, but that a period of onset of less than 48 hours was associated with a 60% mortality. His patients were all older than 1 month.

More than half of the newborn babies in Group C had a period of onset of less than 48 hours, yet all survived. In 5 out of 25 the history was so poor that the period of onset was unknown.

The classification of Adams is easier to apply than one based on onset or incubation and is as reliable. According to this, all the patients in Groups A and B had *severe tetanus*, while those in Group C were mild or moderate with the exception of three. This carries the important practical implication that newborn babies with *severe tetanus* have a 97% chance of developing respiratory failure.

The 25 mild and moderate cases did well without tracheostomy; clear evidence against the view that all newborn babies with tetanus should have tracheostomies. There appear to be none who need tracheostomy but do not need IPPR, since 99% of those with *severe tetanus* developed respiratory failure, while the remaining 3% survived on sedation alone.

It is possible that delaying IPPR until the onset of respiratory failure jeopardizes the infant's chances of survival. The mortality among those patients who were treated in this manner was 53% and this is higher than that of babies who were given IPPR as soon as the diagnosis of *severe tetanus* was made (mortality 36% among the last 100 babies treated in this unit).

Summary and Conclusions

An investigation on the place of tracheostomy in tetanus neonatorum reveals that: (1) tracheostomy alone does not confer any benefit; (2) intermittent

positive pressure respiration is the treatment of choice for *severe tetanus neonatorum* as most of these infants develop respiratory failure; and (3) those with mild and moderate tetanus do well without tracheostomy or intermittent positive pressure respiration.

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